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17 JUN 2002

17JUN02 E726234-4 002820
~~P01/7700 0.00-0213813.9~~

1. Your reference	P03444GB
2. Patent application number *(The Patent Office will fill in this part)*	0213813.9
3. Full name, address and postcode of the or of each applicant *(underline all surnames)*	RUNFLAT INTERNATIONAL LIMITED PO Box 1 Gawne Lane Cradley Heath West Midlands B64 5QY England
Patents ADP number *(if you know it)*	8404030001
If the applicant is a corporate body, give the country/state of its incorporation	GB
4. Title of the invention	SEGMENTED RUN-FLAT DEVICE
5. Name of your agent *(if you have one)* "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	LAURENCE SHAW & ASSOCIATES Metropolitan House 1 Hagley Road, Edgbaston Birmingham B16 8TG
Patents ADP number *(if you know it)*	13623001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Yes

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Continuation sheets of this form	
Description	12
Claim(s)	2
Abstract	1
Drawing(s)	5

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature *Laurence Shaw & Associates* Date *17/6/02*

LAURENCE SHAW & ASSOCIATES

12. Name and daytime telephone number of person to contact in the United Kingdom — Keith Leaman 0121 454 4962

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Agents ref: P03444GB

SEGMENTED RUN-FLAT DEVICE

This invention relates to vehicle wheels that have inflatable tyres and in particular to devices that are fitted on the rim of a wheel inside the tyre to enable the wheel to run with a deflated tyre. Such devices will hereinafter be called "run-flat devices".

With conventional wheels that are not fitted with run-flat devices, when the tyre becomes deflated the tyre becomes damaged and can become shredded or thrown off the metal wheel rim. This can cause the vehicle to which the wheel is fitted to loose control thus endangering other road users.

At best the vehicle can be stopped and the wheel replaced with a spare wheel, or the puncture repaired, or a new tyre fitted to the existing wheel. For commercial vehicles, such as lorries, this is very time consuming and costly because of the need to acquire specialist breakdown or repair services to get the vehicle back on the move again.

With lorries, military vehicles, carriers such as bullion carriers, security vehicles, or other vehicles where a puncture of a tyre effectively halts the vehicle and exposes the vehicle to danger from an external threat, there is a need to be able to continue with the vehicle journey irrespective of the deflated tyre.

When a tyre deflates partially or completely, the effective diameter of the wheel with the deflated tyre becomes relatively smaller compared with the wheels with inflated tyres. Therefore, the frictional engagement of the deflated tyre on the road causes the peripheral speed of the deflated tyre to increase to match the peripheral speed of the inflated tyres. Simultaneously, any differential gearbox in the transmission drive path to a wheel with a deflated tyre will divert torque away from the driven wheels with inflated

tyres to the wheel with the deflated tyre. This in turn causes rotation of the tyre relative to the metal wheel particularly where the metal wheel is a driving wheel.

Run-flat devices that fit on the rim of the metal wheel inside the tyre are well known, and usually comprise an annular body on to which that part of the outer circumferential wall of the tyre that is in contact with the ground or road can sit. The annular body is usually made in two parts that are clamped to the outer rim of the metal wheel and the annular body designed to slip circumferentially on the metal rim when the tyre deflates. This slippage is important because it allows the tyre to slip on the wheel rim whilst ensuring little or not slippage of the tyre relative to the outer circumference of the annular body.

In a prior known device, the annular body comprises two semi-circular segments that are pivotally connected together at each end by a single clamping bolt, that clamps the two segments together. Radial clamping of the segments onto the metal wheel is achieved by a cylindrical band extending around the circumference of the segments that can be tightened to pull the segments together. In this case the pivotal connection at one end of the segments has an elongate slot through which the clamping bolt passes that allows circumferential movement of the segments relative to each other to clamp them on to the rim of the metal wheel. The bolt is accessible for tightening from only one side of the segments.

In a second prior known form of run-flat device having two segments, A single ccircumferetial clamping means is used at one end of the segments. At the other end a simple pivot is provided. The clamping means comprises a slot in one of the segments and the slot has an inclined surface. A tapered wedge is provided in the slot and engages the inclined surface. A single bolt (accessible from one side) passes through

holes in each end of adjoining segments. At least one of the holes is elongated to allow relative circumferential movement of the segments. By tightening the single clamping bolt, the two ends of the segments are pulled together by the wedge to clamp them on to the rim of the metal wheel.

One problem with both of these known types of segmented run-flat devices is that because a single bolt is used at each end of segments, each segment can pivot relative to the other and move out of alignment radially relative to the other segment and this can cause damage to the inside surface of the outer circumferential wall of the tyre when the tyre becomes deflated. This is particularly more of a problem with the prior known run-flat devices that do not use circumferential clamping bands because the two segments tend to open up like jaws under centrifugal and centripetal loads. At worst, even when the tyre is inflated the leading edge of one segment can protrude beyond the circumference of an adjoining segment of the protruding segment and release the frictional engagement of the annular body on the rim of the metal wheel, allowing relative rotational slippage of the run-flat device on the rim of the metal wheel. This causes excessive wear on the run-flat device and the rim of the metal wheel. When the tyre deflates the protruding edges of the displaced segments exacerbates the damage to the inside of the tyre and can cause the annular body to twist out of alignment with a diametric plane of the wheel. This causes further damage that may lead to the tyre coming off the metal wheel altogether.

A further disadvantage of known segmented run-flat devices is that each segment has a single captive bolt that is only accessible from one side of the segments, and the segments are of an asymmetric shape with the design of one end of each segment being different from the other end of the same segment. This means that two different sets of segments have to be made depending on whether the segments are to be fitted

to the left-hand side or to the right-hand side of the vehicle. This adds to the complexity and cost of manufacture and means that extra spare sets have to be carried by puncture repairers or breakdown personnel.

A further object of the present invention is to provide a run-flat device comprising a plurality of segments that are inter-connected by clamping means that restricts relative pivotal movement between the segments.

A further object of the present invention is to provide an annular run-flat device comprising a plurality of arcuate segments with circumferentially spaced clamping means around the annular device at each connection between the segments.

In one embodiment of the invention a further object is to provide a plurality of identical segments that can be interchanged between wheels fitted on the left hand side of a vehicle with those on the right hand side of the vehicle.

According to one aspect of the present as set out in the attached claims at least some of these objects are met by providing a plurality of segments with a plurality of spaced clamping means.

The present invention will now be described, by way of an example, with reference to the accompanying drawings in which:

Figure 1 shows a cross-sectional view through a wheel fitted with a run-flat device constructed in accordance with the present invention;

Figure 2 is a side elevation showing a segmented ring and inner sleeve of the run-flat device of Figure 1;

Figure 3 shows a cross sectional view through the ends of two adjacent segments of the segmented ring of Figure 2 and shows in greater detail the clamping means;

Figure 4 shows a cross-sectional view through one of the segments of the segmented ring and tyre-bead retaining sleeve of the run-flat device shown in Figure 2.

Figure 5 shows a cross-sectional view through a second type of wheel fitted with a run-flat device constructed in accordance with the present invention;

Figure 6 shows a cross sectional elevation through metal wheel showing an alternative bead retaining means;

Figure 7 illustrates an isometric view of the wheel of Figure 6; and

Figure 8 illustrates one pin of the bead retaining means of Figure 6.

Referring to Figure 1, there is shown schematically a cross-section through a wheel assembly of a lorry. The wheel assembly 10 comprises a metal wheel 11 that is constructed so as to be capable of being fixed to a wheel hub of a vehicle (not shown) by way of conventional studs and nuts (not shown) or threaded studs (not shown). An inflatable tyre 12 is mounted on the rim of the metal wheel in a conventional manner. The metal wheel is of a single piece construction of the type in widespread use, and is provided with a conventional inflation valve (not shown).

Mounted on the rim of the wheel 11 inside the tyre 12 is a run-flat device 13 constructed in accordance with the present invention. The run-flat device 13 comprises

an annular body 14 made of three nylon segments 15 that are clamped to the outer circumference of an inner sleeve 16 that is split so as to permit the inner sleeve 16 to be opened and snapped in place around the rim of the wheel 11. The inner sleeve 16 is made of nylon, but it could be constructed with a nylon central band 17 and polyurethane edge bands 18 as shown in Figure 4. The inner circumference of the inner sleeve 16 may be profiled to match the profile of a specific metal wheel, or could simply bridge across the wells or beads of the metal wheel between the surfaces 12(a), 12(b) which the beads of the side walls sit. The inner sleeve must be shaped so as not to impede the fitting of the tyre because it is necessary to provide wells that allow each side wall to fit as the side wall is slipped over the front rim of the metal wheel prior to inflation.

Referring in greater detail to Figure 2, the three segments 51 are of identical shape whether for a left-hand wheel or a right-hand wheel. Each segment is a segment of a hollow cylinder with a concave end 20 and a convex end 21. The convex ends 21 are of a complementary shape to the concave ends 20 so that the convex end 20 of each segment 15 nestles into the concave end 21 of an adjacent segments 15. The segments 15 are assembled inside the tyre 12 with the convex ends 21 constituting the leading edge relative to the direction of rotation of the tyre 12 when it is running wholly deflated. Each segment 15 has an arcuate recess 22 on each side to lighten the segments.

At each end of the segments there is provided a clamping means in the form of two parallel bolts 23(a), 23(b). The shape of the ends of adjacent segments 15 and details of the clamping means is best seen in Figure 3.

Referring to Figure 3 the concave end 20 of each segment has a flange 26 of half the thickness of each segment and two circumferentially spaced holes 24, 25 are drilled through the flange 26. The holes 24 are of a slightly larger diameter than that of the bolts 23(a) and 23(b) to allow relative movement of the end 20 relative to end 21. The convex ends 21 of each segment has a flange 27 that overlaps the flange 26 in a circumferential direction. The flange 27 is provided with an elongate slot 28 that has inclined surfaces 29 that face away from the concave end 20 of the adjacent segment 15.

A wedge 31 having an inclined face 32 that abuts the inclined face 29 of the slot 28 in the convex end 21 of the segment 15 is placed in the slot 28 with the inclined face of the wedge in contact with the inclined faces 29. The wedge 31 has a hole through which one of the dome-headed clamping bolts 23(a) is passed. The ends 21 of the segments have two spaced holes 33, 34 that align with the holes 24, 25 in ends 20. A second dome headed clamping bolt 23b is passed through a hole 37 in a clamping plate 38, through the slot 28 and holes 34 and screwed into the second captive nut 35.

The clamping plate 38 bridges the slot 28 and is shaped so as not to interfere with bolt 23(a). When bolt 23(b) is tightened the clamping plate 38 pulls the two flanges 26, 27 axially.

To fit the run-flat device 13, the rear side wall of the tyre 12 is levered on to the front rim of the metal wheel 11 and then the inner sleeve 16 is prised open and fitted over the rim of the metal wheel inside the deflated tyre 12. The slit 39 in the inner sleeve 16 is positioned to align with the inflation valve of the wheel (not shown). The segments 15 are loosely assembled around the inner sleeve 16 with the heads of the bolts 23(a), 23(b) facing outwards. The wedges 31 are then tightened down by tightening the bolts

23(a) evenly, and this causes the wedges 31 to pull the segments 15 together and thereby clamp the segments 15 firmly to the inner sleeve 16 and clamp the inner sleeve 16 to the rim of the metal wheel 11. With the run-flat device 13 clamped on to the rim of the metal wheel 11 the bolts 23(b) are fully tightened to clamp the flanges 26 and 27 together axially. The outer side-wall of the tyre 12 is then levered over the front rim of the metal wheel 11 and the tyre 12 inflated.

Two captive nuts 35 are mounted on a retaining plate 36 and the nuts are inserted into the holes 33, 34 in the flanges 27. By tightening the first bolt 23 the wedge 31 urges the ends of the segments together in a circumferential direction.

In use, when the tyre 12 deflates, the tyre 12 collapses onto the outer circumferential surface of the run-flat device 13 in the region where the tyre 12 contacts the ground or road. This causes the run-flat device 13 to slip circumferentially on the rim of the metal wheel 11 and hence there is little, or no, relative rotation between the tyre 12 and the run-flat device 13 and little or no damage to the tyre 12. The beads of the side-walls of the tyre are prevented by collapsing inwards by the inner sleeve 16 which acts as a bead retainer.

Referring to Figure 4 there is shown a modification to the interface connection between the run-flat device 13 and the inner sleeve 16. In this embodiment, the central band 14 of the inner sleeve 16 is made of nylon and the side edges 18 of the sleeve 16 are made of polyurethane as discussed above. The central band 14 provides rigidity to resist side-loads whilst the polyurethane side bands 18 provide rigidity with slightly more flexibility or resilience than the nylon to cushion the contact between the beads of the side-walls of the tyre 12 when the tyre deflates.

The outer circumference of the central band 39 has a recess 41 and the inner circumference of the segments 15 have a flange 42 that locates in the recess 41.

It will be appreciated that at high rim speeds, the run-flat device 13 is subject to centripetal and centrifugal forces which tend to loosen the circumferential grip of the run-flat device 13 on the metal wheel 11. A shear pin 43 is provided for each segment 15 to accommodate this radial movement but restrain the segments 15 circumferentially until the pins 43 are sheared by the deflated tyre contacting the segments 15.

Referring now to Figure 5 there is shown a second type of metal wheel fitted with a run-flat device 13 of the present invention. In this design of wheel the metal wheel 11 is in two parts 44 and 45. The main part 44 of the wheel constitutes the rear rim 46 and central rim 47 of the wheel on to which the rear wall of the tyre 12 is fitted and the second part 45 constitutes the front rim 48 that retains the front side wall of the tyre 12. The second part 45 is bolted to the main part 44 of the wheel prior to inflation of the tyre 12. The run-flat device 13 is of a similar construction to that described and shown in Figures 2 to 4.

It will be appreciated that the inner sleeve 16 shown in Figure 1 effectively blocks off the deep wells formed in the rim of the metal wheel and serves to stop the side walls of the tyre falling into the deep wells when the tyre deflates. Clearly in those designs of metal wheel that do not have deep wells and those that have cylindrical or slightly conical central rims with in-built bead retaining features (such as for example similar to that shown in Figure 5) the inner sleeve 16 may be dispensed with. However we prefer to keep the inner sleeve 16 as an additional bead retainer.

Referring to Figures 6 to 8 there is shown a metal wheel 11 with an alternative design of bead retaining means that can be used with the run-flat device 13 of the present invention with or without the inner sleeve 16. The metal wheel 11 has two spaced conical surfaces 49 and 50 onto which, in use, the bead of an inflated tyre sits. For clarity the tyre is not shown in Figure 6 to 8. The rim of the metal wheel includes a raised section 51 that forms a bead retaining lip to stop the rear wall of the tyre slipping into the central well 52 of the metal rim when the tyre deflates. The front rim of the metal wheel does not have a bead retaining lip. Instead it has a well 54 adjacent the surface 50 onto into which first the rear side wall of the tyre and then the front wall of the tyre is located when fitting the tyre, prior to inflating the tyre. When the tyre is inflated, the side walls of the tyre are pushed up the conical surfaces 49, 50 to sit against the front and back rims 53 and 56 respectively of the metal wheel.

The bead of the front wall of the tyre is prevented from collapsing into the well 54 when the tyre deflates by a plurality of screw threaded pins 57 equispaced around the metal rim between the well 54 and the surface 50 on which the tyre sits. Each pin 57 has a screw threaded portion that is screwed into a threaded hole 58 and in use projects into the interior of the inflated tyre a sufficient distance to stop the front wall of the tyre coming off the surface 50.

In order to fit a tyre, it is necessary to remove all the pins 57 and prise both the rear wall and then the front wall of the tyre over the front rim 53 of the wheel.

If it is desired to use the bead retaining pins 57 with a run-flat device 13 constructed in accordance with the present invention (or indeed any other design of run-flat device) the run-flat device 13 is fitted to the metal wheel rim after the rear wall of the tyre has

been slipped over the front rim 53 of the metal wheel but before the second wall of the tyre is fitted.

Prior to fitting the pins 57 the tyre must be inflated to push the side walls up the inclined surfaces 49, 50 and against the front and back rims. To do this, the pins 57 have to be retracted and the holes 58 in which they locate sealed by temporary bungs (not shown).

Once the tyre is inflated, the tyre is deflated but with the side beads left sitting on the surfaces 49, 50. The sealing bungs are removed and the pins 57 are then screwed into place and locked in place either by a screw thread locking compound or by way of a lock plate (not shown) or other means that will prevent the pins 57 from inadvertently coming loose. In order to stop air leaking out in the vicinity of the pins 57 the pins 57 must be adequately sealed in the metal wheel.

It is believed it may be possible to adapt conventional air inflation valves to fulfil the role of the pins 57. In this case all of the pins 57, except one which is used as an inflation valve, are constructed in the form of a conventional inflation valve as shown in Figure 8 with the inner valve removed and a solid central member screwed in the bore of the valve stem. Referring to Figure 8 there is shown a hollow valve stem 59 with a resilient seal 60 that locates and seals the holes 58 in the metal wheel. The valve stem 59 has an internally threaded bore that in normal use would carry the valve mechanism. The valve mechanism is replaced by an externally threaded solid inner member 62 that has a seal 63 that contacts the end of the valve stem 59 to prevent leakage of air through the bore of the stem 59. The inner member 62 projects beyond the valve stem 59 into the space inside an inflated tyre. When the tyre deflates, the front side wall is caught by the pins 57 and remains on the surface 50. A locking ring, not shown, can be used

to hold all of the inner members in place to prevent them from unscrewing or thread locking compound could be used.

It is to be understood that if desired a second set of bead retaining pins 57, similar to those shown in Figures 6 to 8 can be used in place of the bead retaining lip 51 to catch the rear wall of the tyre when it deflates.

CLAIMS

1. A run-flat device for fitting on the outer circumference of a wheel inside an inflatable tyre, said device comprising an annular ring made up of a plurality of arcuate segments interconnected at each end by a clamping means equally spaced around the ring that imparts to each segment a circumferential clamping force and an axial clamping force to urge the segments circumferentially and axially towards each other.

2. A run-flat device according to claim 1 wherein there is provided a split inner sleeve for fitment to the rim of the wheel onto the outer circumference of which the segments sit.

3. A run-flat device according to claim 2 wherein the inner circumference of the inner sleeve is profiled to match the profile of the outer circumference of the wheel.

4. A run-flat device according to claim 2 or claim 3 wherein the outer circumference of the inner sleeve has a recess, and each segment has a flange on its inner circumferential surface that engages in the recess on the inner sleeve.

5. A run-flat device according to any one of claims 1 to 4 wherein the inner sleeve comprises a central band and two side bands made of a material that is more resilient than the material of the central band.

6. A run-flat device according to claim 5 wherein the central band is made of nylon.

7. A run-flat device according to claim 5 or claim 6 wherein the side bands are made of polyurethane.

8. A run-flat device according to any one of the preceding claims wherein the segments are identical in shape.

9. A run-flat device according to any one of the preceding claims wherein the segments have a flange at each end that overlaps circumferentially the flanges of adjacent segments.

10. A run-flat device according to claim 9 wherein the clamping means comprises a slot that includes an inclined surface that faces away from the immediately adjacent segment provided in one of the flanges at one end of each segment, a pair of spaced holes that align with each other, a wedge provided in the slot, said wedge having an inclined surface that contacts the inclined surface of the slot, and having a hole that aligns with a first of the pair of spaced holes in the flanges, and a first clamping bolt that passes through the first of the pairs of holes and the hole in the wedge whereby tightening of the first bolt causes the wedge to urge the segments towards each other circumferentially, and the clamping means further includes a second bolt substantially parallel to the first bolt, said second bolt passing through the second of the pair of holes in the flanges and through a clamping plate in contact with a side face of the segment whereby tightening of the second bolt clamps the flanges of the segments together axially, and the combined clamping effect of the two bolts restricts pivotal movement of the segments relative to each other.

ABSTRACT

A run-flat device (13) for fitting on the outer circumference of a wheel (11) inside an inflatable tyre (12), said device (13) comprising an annular ring made up of a plurality of arcuate segments (15) interconnected at each end by a clamping means (23a, 23b, 28, 29, 35) equally spaced around the ring that imparts to each segment a circumferential clamping force and an axial clamping force to urge the segments circumferentially and axially towards each other.

KLJW/P03444GB
June 17, 2002

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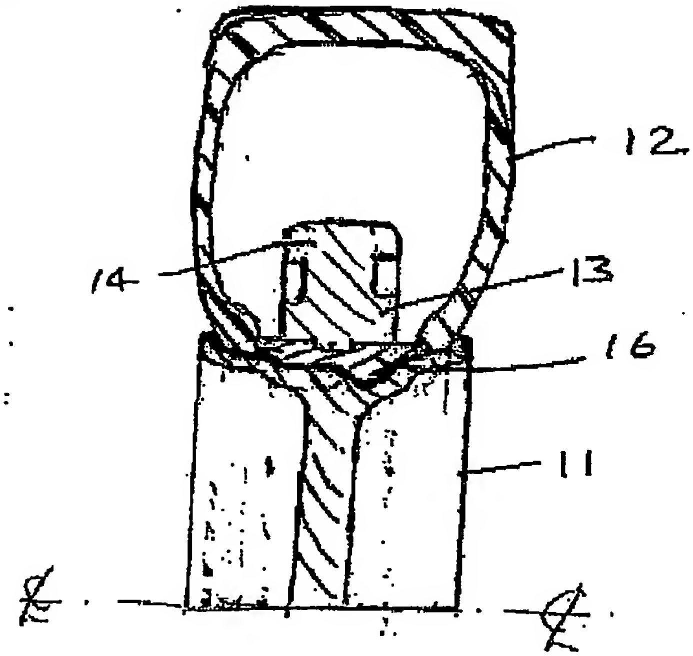
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FIG 1.

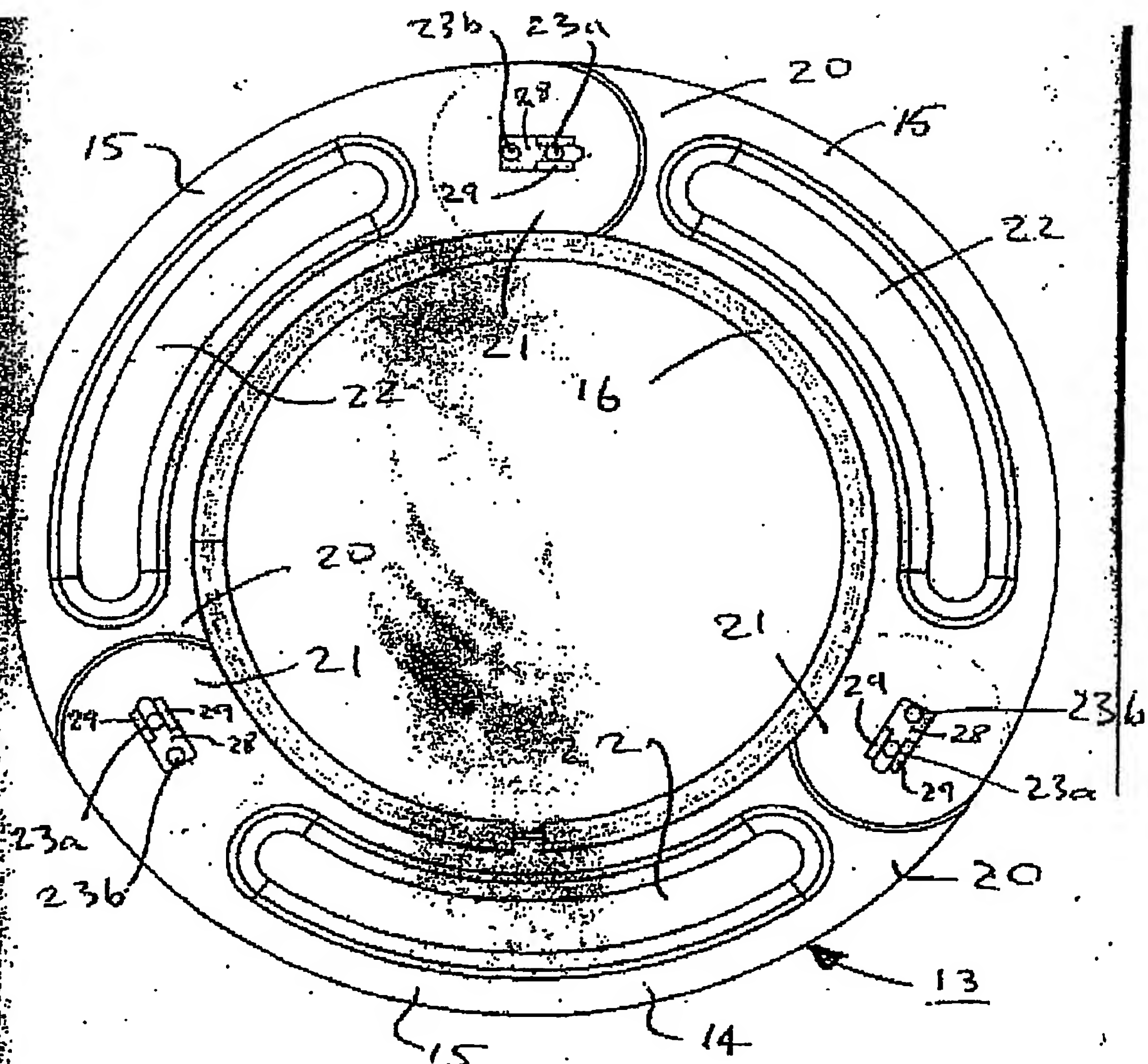
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FIG 2.

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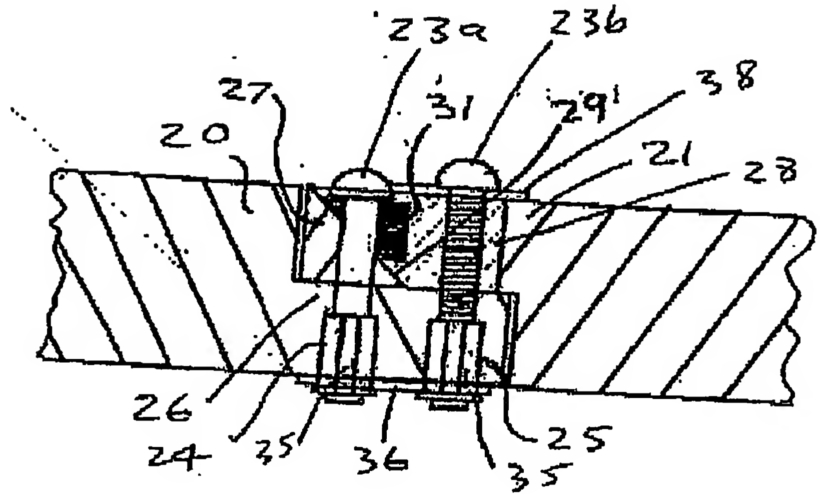
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FIG. 3

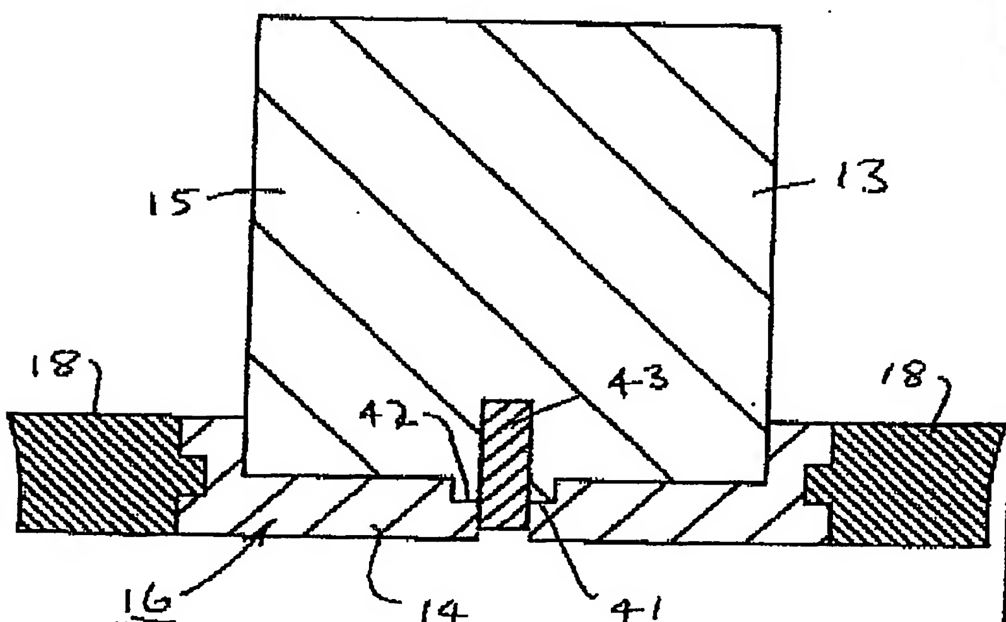
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FIG. 4.

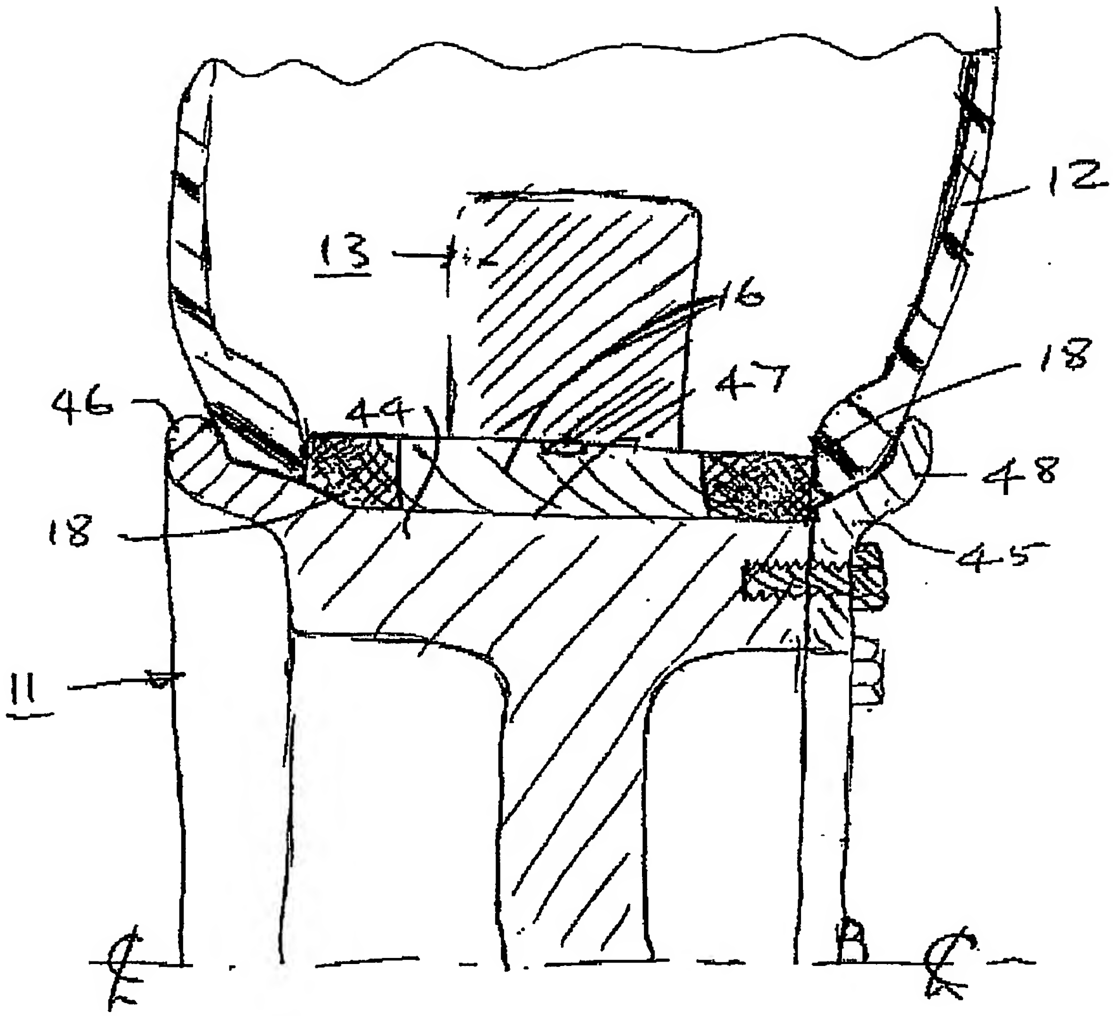

FIG 5.

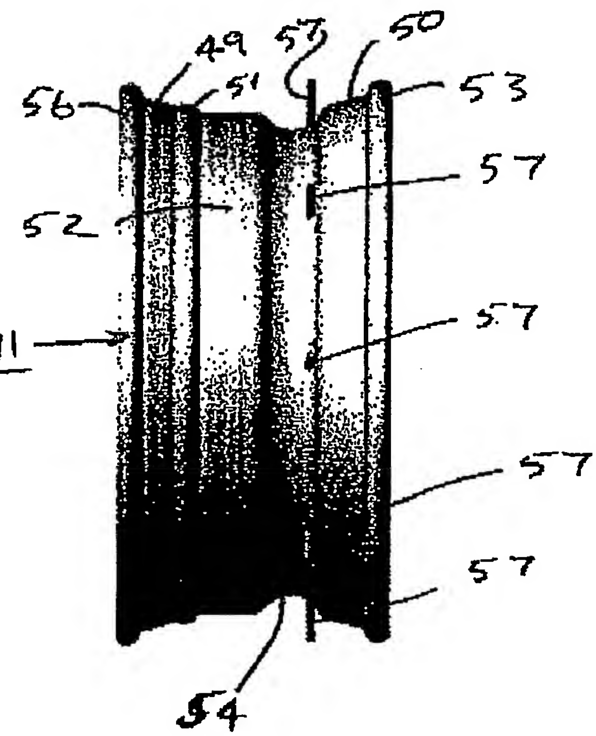

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FIG. 6

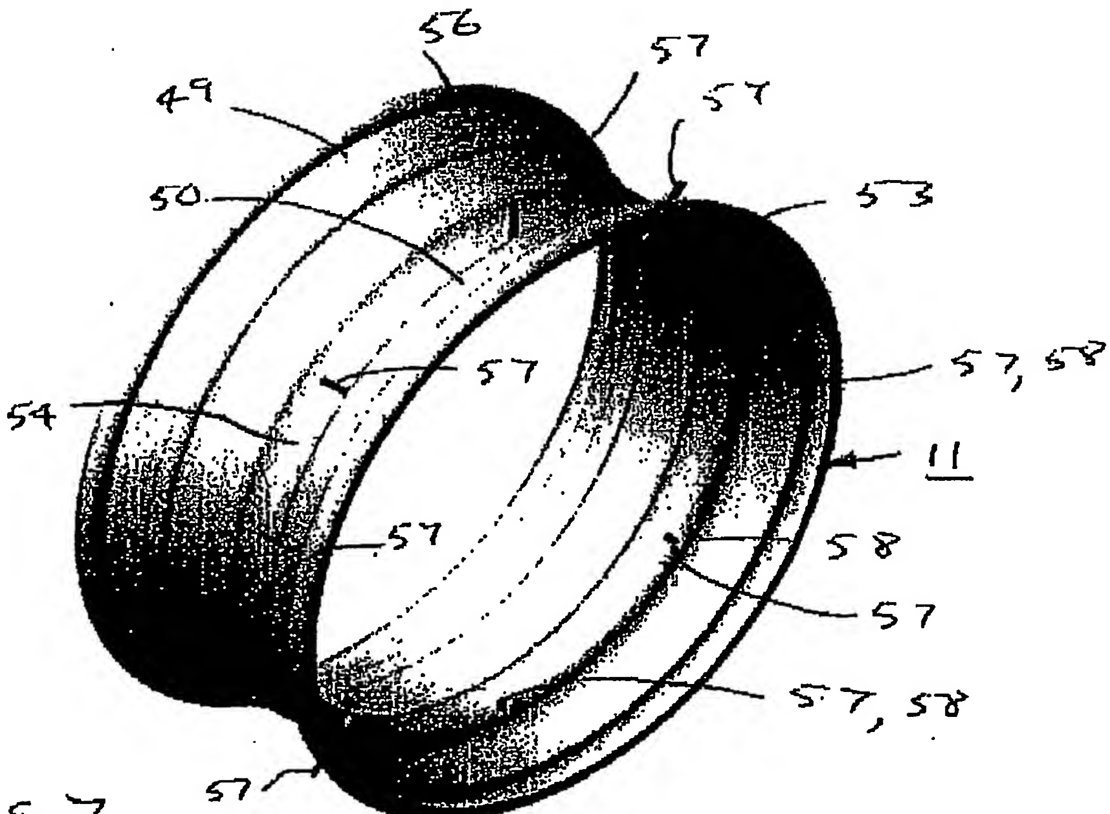

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FIG 7.

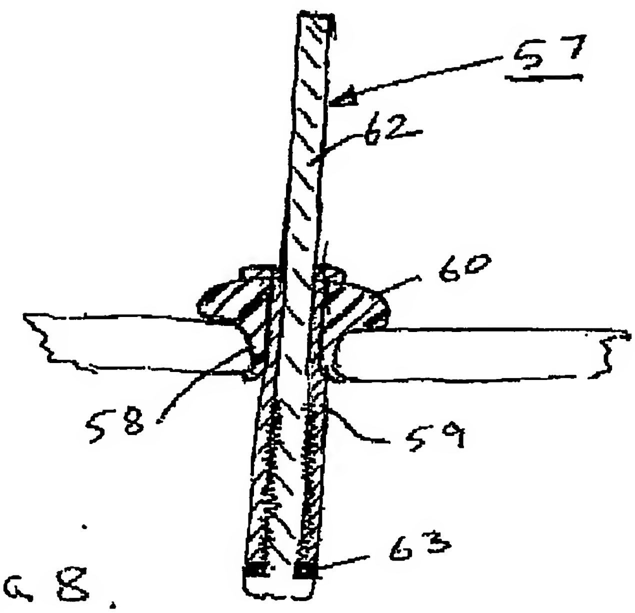

FIG 8.